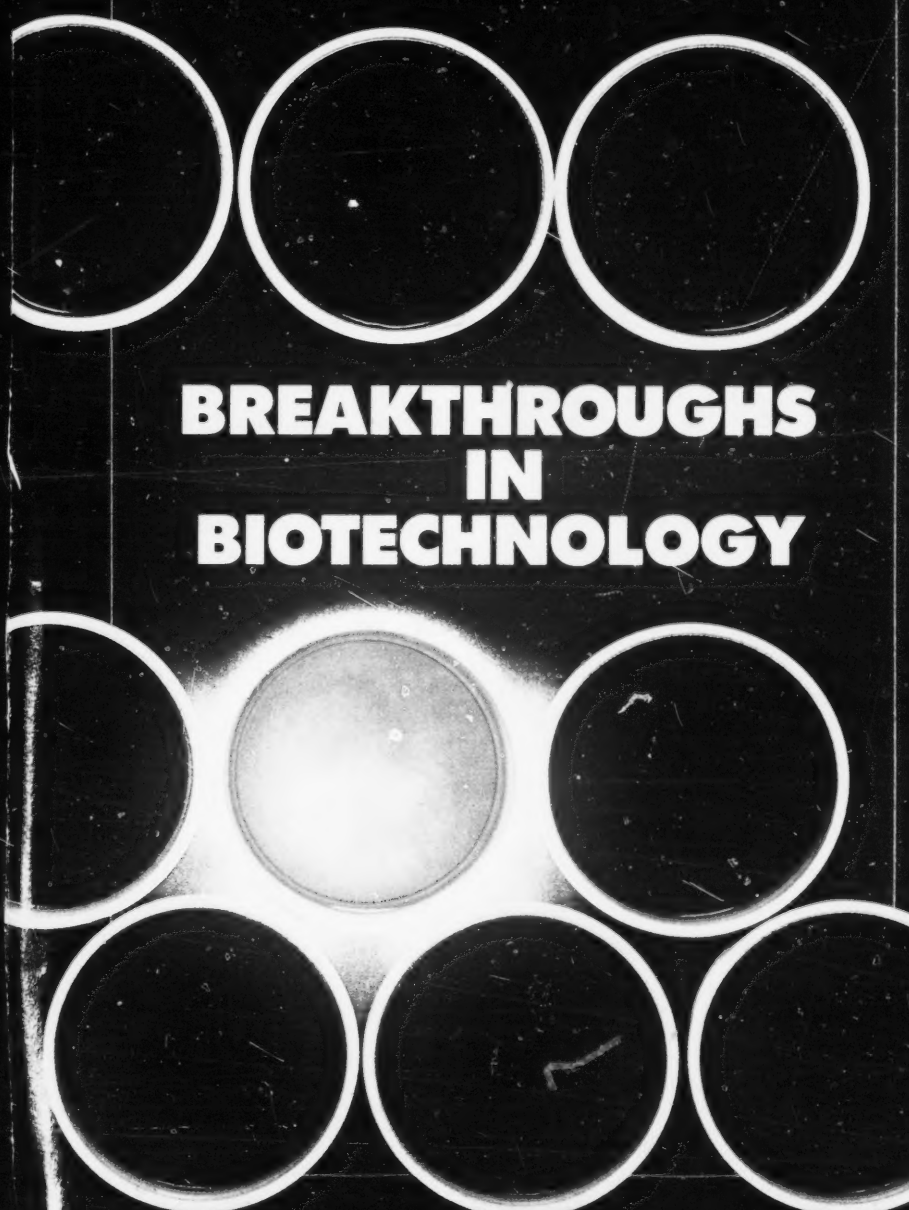
FEBRUARY 1986

food engineering

In this issue: **FOOD PACKAGING**



BREAKTHROUGHS IN BIOTECHNOLOGY

BIOTECH...A PIPEDREAM NO MORE

Engineering foods takes on a whole new meaning as we unravel the mysteries of biotechnology.

NABISCO BRANDS BETS $42 MILLION ON R&D

While others shirk from investing in R&D, Nabisco Brands surges ahead.

FLAVORS SURVEY/PART 1

Special emphasis coverage of the trends and technologies shaping new flavor development.

Chilton's
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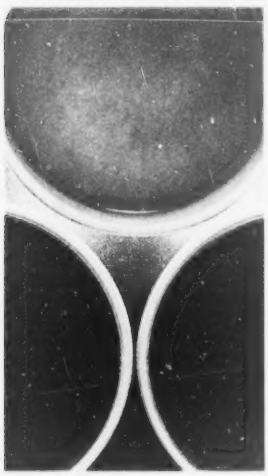

COVER STORY

This month's cover story takes an in-depth look at biotechnology, the subject of discussion at a recent symposium at the University of Minnesota. Attendees from 25 nations shared their expertise in the application of biotechnology in the food processing industry.

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Despite the recent FDA ruling approving low-dose fruit and vegetable irradiation, experts agree the technology will never earn a position among the more traditional food preservation methods—such as canning and freezing.

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INSTANT, AUTHENTIC, ETHNIC FOOD: Basic American Foods has introduced refried beans, dehydrated by a new method, to the ethnic foods market. **PAGE 25**

NABISCO RESEARCH ADAPTS: An exclusive interview at Nabisco Brands takes us inside the company's recently opened $40 million research center. **PAGE 61**

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Food Packaging

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One segment of the recent Ryder Conference examined the rapid growth of the use of containers made of crystallized polyester (CPET). How CPET is nailing down a niche in dual-ovenable packaging.

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45 Swanson's Showdown
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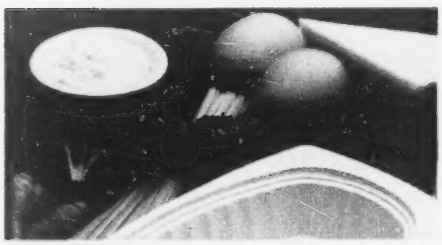

POLYCARBONATE TRAYS: General Electric enters the competition in the dual-ovenable tray market with its line of heat-resistant resins. **PAGE 42**

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HIGH-SPEED CASE ERECTOR: International Paper's case erector boosted Holly Farms' packaging production by 25% and reduced labor costs 25%. **Page 84**

Special Emphasis

FLAVORS/ PART I:
This month's Special Emphasis section is the first of a two-part series covering the latest advances in the flavors industry. What challenges are presented to the flavors industry? How are they responding to the challenge? Part II will appear in the April issue. Pages 69 to 74

Ryder Conference looks at...

CPET Trays

Crystallized polyester trays move into the "fast-lane" of the race for the frozen food tray market.

The rapid success of crystallized polyester (CPET) food trays and other dual-ovenable package ideas owes much to a single idea: That a microwave oven is no longer a luxury but a necessity. By the end of this year, or early into 1987, microwave ovens should reach 50 percent market penetration in the United States.

This is important because the mainstay of frozen food packaging in America has been the aluminum tray. And, despite the efforts of aluminum associations, manufacturers and the like to prove that aluminum can, under most circumstances, be used safely in microwave ovens, it's not a message getting through to most of America. And, despite the fact that aluminum can be coated for a more attractive presentation, some food processors think other materials are more table-presentable.

While the number of aluminum alternatives are many, one of the "hottest" new contenders is a plastic tray manufactured from crystallized polyester. CPET trays are not seen as a replacement for earlier compression molded, thermoset PET trays but they are probably more versatile and less expensive.

An excellent survey of CPET as a dual-ovenable contender was presented recently during one portion of the Future-Pak Conference in Atlanta, GA, sponsored by Len Ryder Associates. This report summarizes some of the CPET presentations at that meeting. The conference also covered topics such as controlled atmosphere, coextruded plastics, and aseptic packaging.

This photo, supplied by Goodyear, illustrates how broadly CPET packages are penetrating the dual-ovenable container market.

Barry Cristea of Goodyear, a major PET resin supplier, wasted little time in laying out a bright future for CPET. "Based on recent successes and current market conditions," Cristea said, "Goodyear projects that 100 million CPET trays will be used during 1985. This figure will grow to over 2 billion trays by 1990."

While acknowledging that CPET trays cost more than traditional aluminum trays, Cristea pointed out that with increasing emphasis in the frozen food case on premium priced entrees and other foods, the package does not have to compete with aluminum on price alone. "CPET projects an image of convenience and quality that meets the needs of today's consumer," Cristea suggested. "In addition to these factors, tray design and pigmentation enable the food processor to tailor a package to a specific market."

He has a point. Sales gains in the frozen entree and dinner segments have been strong over the past two years and especially so in the premium gourmet market. Cristea says total sales are up over 30 percent with growth in the premium segment in excess of 50 percent during the period.

While CPET is perhaps the "hot" material in dual-ovenable packaging, it's not without its problems. Before looking at some of these, consider how CPET containers are made.

Manufacture of CPET trays begins at the tray converter's plant with the extru-

sion of a sheet of amorphous polyester. This sheet is crystallized during the thermoforming operation. Regular PET will heat crystallize in around 20 seconds. Converters have been able to slash that time to 4-8 seconds with the use of nucleating agents and other process aids. Achieving the right degree of crystallinity is critical to making trays with an acceptable low temperature impact strength. Trays with high crystallinity are often brittle.

Another key to CPET container economics is the ability to recover scrap as use it as regrind material. In many cases up to 30 percent regrind may be used to make CPET trays. Experimental work in using up to 40 percent regrind was discussed by Goodyear. The economics of scrap recovery/usage will go a long way toward further improving the economic position of CPET trays in the market.

While CPET trays are acknowledged to cost more than most other alternatives for dual-ovenable packaging, they have other limitations as well.

•*Need for higher heat PETS.* Crystallized PET is stable up to around 425 degrees F which is acceptable to the great majority of applications. But some ovens, especially commercial baking ovens, for instance, have so called 'hot-spots' that could melt even a fully crystallized PET.

•*Colors.* White is nice but there's a growing demand for colors. Achieving a wider range of colors for CPET trays would make the material more competitive with other plastics and plastic/paper combinations.

•*Crystallizing efficiency.* As mentioned earlier, normal crystallization can take as long as 20 seconds but, by the converter adding nucleating agents, that time can be slashed considerably. But how and how much of these external agents are added can vary from converter to converter and thus effect crystallization efficiency and quality.

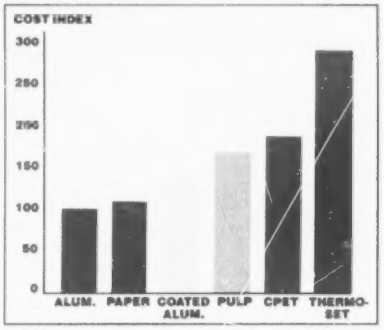
PET resin suppliers say they either have or will soon have answers to these limitations. Joseph Stras of Eastman Chemical noted three new developments.

One new idea Stras points to is a new PET with an approximate 50 degree F higher melting temperature which should bring PET's heat resistance up to around 480 degrees F and meet the challenge of oven "hot-spots".

Variance in crystallization could soon be solved with integrated nucleating agents. Instead of the converter adding them, Eastman would factory-integrate the nucleating agents so critical to crystallization, thus eliminating any guesswork on the part of the converter.

In some cases, adds Stras, it will be possible to purchase PET pellets with both integrated nucleating agents and colors. "We've always had a leadership position in adding colors," continues Stras, "now we're further improving that technology. We realize colors are important in marketing food items because the company's image is carried with the package as well as the food."

Cost Index Comparison
Standard Dinner Tray



ABOVE: While CPET may cost more than many other alternatives, higher volumes should bring costs down. index source: Goodyear.

BELOW: Container economics for system producing 36.7 million containers per year. For more details on parameters going into this calculation either refer to the Future-Pak '85 Proceedings or contact A.R. Freedman, John Brown Machinery, Warwick, RI.

Container Economics
Annualized Costs, $

Material	$ 2,915,650
Material Losses (2.5%)	72,890
Direct Labor	522,000
Indirect Labor	261,000
Utilities	72,890
Building Rent	140,000
Depreciation (7 year SL)	247,150
Working Capital (3 months at 12%)	120,570
Taxes and Insurance (2% of Capital)	34,600
TOTAL ANNUAL PRODUCTION COST	$ 4,386,750
COST PER CONTAINER	**$0.12**

How the ovenable/dual-ovenable market could shake-out by 1988

	Billion units
Aluminum	2.0
PET Coated Board	2.0
CPET	.8
Fiber/PET Film	.8
Thermoset PET	.4

Source: Eastman Chemical

CPET economics

Tray manufacture economics were well presented in a special paper by three spokesmen from John Brown Plastics Machinery. To meet the anticipated U.S. demand for CPET containers, the presenters suggested the most probable production approach would be a dedicated production system. As an example, they laid out the economics of producing 36.7 million containers per year, including a co-extrusion sheet line, thermoform and trim line, reclaim equipment, and material handling equipment. Including labor, utilities, resin, depreciation and other economics the total annual production costs came to just over $4.3 million or $0.12 per container.

Europe's CPET growth

CPET tray growth has not been limited to the U.S. Dieter Schoenwald of West Germany's ETIMEX said that while microwave oven sales in Europe are far behind the U.S. pace, it is, nonetheless, a significant trend in Europe where the frozen food market is growing at a robust 10 percent a year.

By contrast with the U.S., says Schoenwald, about one million microwave oven units were sold. Microwave oven sales in the U.S. for 1985 will probably hit the 10 million mark. Within Europe, the United Kingdom is the chief consumer of microwave ovens with about 10-12% of households owning one.

Based on Etimex's estimates the European market in 1986 will consume 130 million CPET trays, growing to 300 million by 1988.

A book containing the proceedings of Future-Pak '85 is available from Ryder Associates, Inc., Five Sharon Drive, Whippany, NJ 07981.

FLAVORS I: THE SEARCH FOR NATURAL SAVORY & DAIRY FLAVORS

The flavor industry has been busily pursuing the development of new flavors—especially natural—to meet the demands of an increasingly "health conscious, active" population.

The impact of today's changing lifestyles is immediately apparent on grocery store shelves. Higher quality, premium-priced entrees continue to thrive; foods are being reformulated for microwave preparation; "on-the-go" consumers are eating more snacks; and label claims reflect a growing consumer awareness about nutrition.

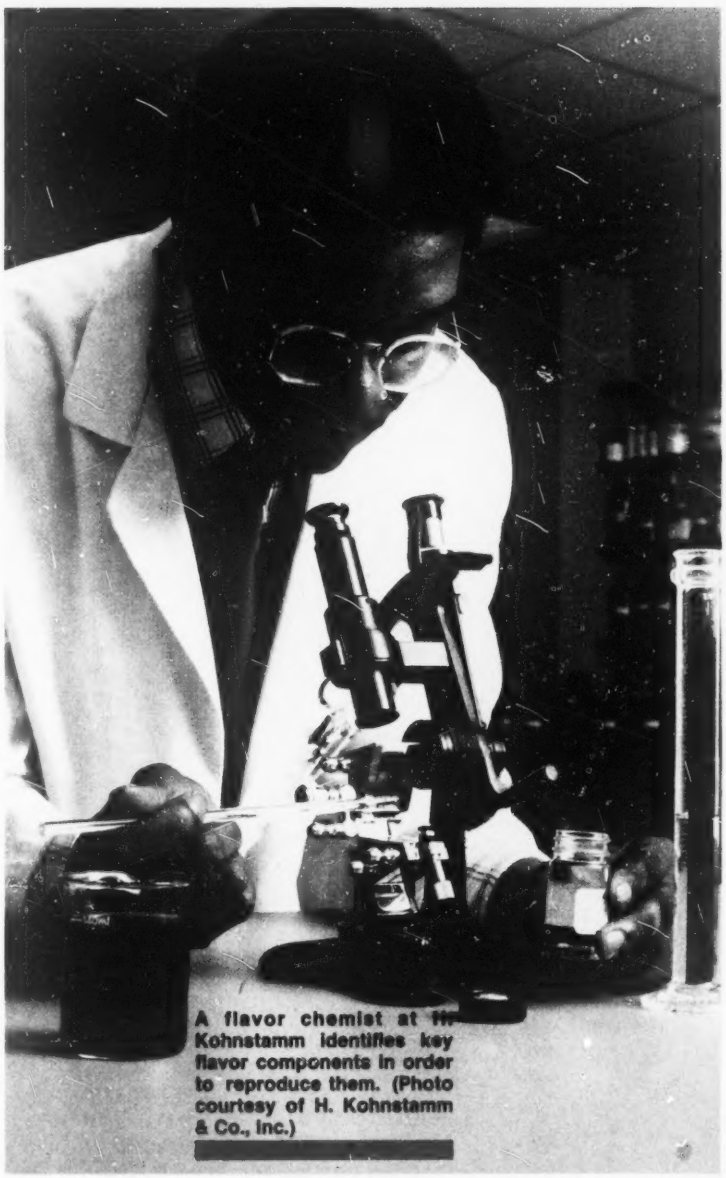
While all these changes affect the food industry profoundly, the food industry has, in turn, passed a major portion of these challenges back to flavor suppliers. Flavor suppliers are a unique group. Some companies are huge, providing fragrances and other essences as well as flavors. Many are small, dedicated exclusively to flavors for the food industry. Competition is sometimes fierce in an industry where everyone seems to know everyone else. In many ways, flavor suppliers around the world are not an "industry" as much as a community.

So what is this community identifying as its major technical challenges today and how is it moving to solve them? That's the essence of this two-part report on flavors.

"Naturalness, self awareness and healthy," are the three major driving forces spurring today's new food product activity explains Bill

ANN E. PRZYBYLA
Technical Editor

(Continued on page 70)



A flavor chemist at H. Kohnstamm identifies key flavor components in order to reproduce them. (Photo courtesy of H. Kohnstamm & Co., Inc.)

Source: Frost & Sullivan

Sales of flavors are expected to grow over the next four years according the Frost & Sullivan, Inc. In its report, "U.S. Flavor & Fragrance Market", the New York-based marketing research company provides statistics on this industry.

Zick, vice president of business development for the flavor division of International Flavors & Fragrances, New York.

"With increasing levels of customer service demands and legislative restrictions, the (flavor) companies are having to increase their capital spending and research and development funding," states analysts at Frost & Sullivan, Inc.—a New York City-based marketing research company.

"The flavor industry is faced with the task to use natural raw materials as much as possible and still hold the line on manufacturing costs. The houses will also have to take a closer look at economic recovery of available natural flavors which may involve new processing techniques to protect delicate, evanescent and heat sensitive components," continues F&S.

Not only are consumers looking for products with natural flavors, they want the products to be of high quality. This, in combination with more convenient foods, which require less cooking time at home during which flavors develop, has led to the development of process or reaction flavors.

Flavors for processed foods

The use of processed or reaction flavors is becoming more wide-spread. These flavors can be divided into four groups according to the method used in their development. These are: thermal or heat development of flavor; chemical treatment plus the possible use of heat; enzyme treatment of raw material; and fermentation by the use of micro-organisms.

The thermal development of flavors can involve either the Maillard reaction or nucleotide degradation. Oxidation, hydrolysis, sulfonation and the manufacture of hydrolyzed plant proteins (HPP) are examples of chemical treatments used in flavor development. Enzymes are used in the production of both autolyzed yeast extracts and modified cheeses. And, soy sauce is an example of a flavor which is produced by fermentation.

Much of the work of processed flavors is in the area of meat flavors due to their increased usage in high quality entrees, sauces and other savory-flavored foods. These meat flavors are often developed using several of the methods listed above.

Hydrolyzed plant proteins are produced by acid hydrolysis. A grain source such as rice, wheat, soy or corn is added to water in a reaction vessel. The grain is selected based on the desired end product and economics. Acid is then added (its level affects the end product), and the mixture is subjected to elevated pressure and temperature. Approximately 99% of protein is converted to amino acids. This mixture is neutralized and purified resulting in a basic meat-like flavor such as beef or chicken.

A second generation of flavors involves adding other ingredients to the HPP such as dextrose, thiamine or monosodium glutamate and heating under controlled conditions to achieve a more specific flavor. The result could be a roast beef flavor rather than just beef flavor. The third generation would produce an even more specific flavor such as rare roast beef. To achieve this, the amount of specific amino acids in the final product is controlled.

"A smoother, rounder meat flavor than provided by HPPs can be obtained with the use of autolyzed yeast products," explains Marshall Bozzi, Manager of Technical Support for FIDCO, White Plains, N.Y.

In the development of these flavors, enzymes naturally present in the yeast are used to produce an end product with 25 to 30% amino acids, the balance being polypeptides and peptides. (For a more extensive explanation on autolyzed yeast products see *Food Engineering*, Jan. 1986, p.70).

The future challenge in the development of these and other reaction flavors is to identify other components from natural sources that contribute to the desired end flavor.

New flavors for snacks

Another trait that typifies today's consumer is his or her "on-the-go" life style which, in turn, has produced an "on-the-run" eating pattern. This is reflected in the explosive snack food industry where sales have tripled over the past decade. Especially high increases have been seen in the sales of engineered meats, surimi, breaded chicken bits and flavored extruded snacks.

The growing popularity of surimi-based products in this country has created the need for more seafood flavors. And, with the increasing popularity of these engineered seafoods an growing number of Japanese flavor companies have appeared in this country. A major reason behind this is the Japanese saw the opportunity to share an expertise they have had well in place for many years.

"In Japan, more types of seafood are utilized than in the U.S., and sanitary conditions are in place for utilizing a greater portion of fish as food. In otherwords, the basic ingredients that go into making a good seafood flavor have been utilized as food in Japan long before surimi became popular in the U.S.," points out Edward W. Onyskow, senior food chemist at Takasago Corp., U.S.A., Teterboro, N.J.

Other companies, though, are introducing flavors developed exclusively for surimi products. One example is a new line of shellfish

flavors for the surimi market from Givaudan Corporation's Flavor Division. The line is available as both natural and artificial.

Takasago, the largest flavor company in Japan, emphasizes its commitment to doing business in this country by pointing out that it has purchased its manufacturing facilities in the U.S. rather than leasing. In addition, fermented and other types of dairy flavors will be produced in the U.S. for export to Japan because of the better availability of raw products in this country. Among the flavors included in this area are enzyme modified cheeses.

Enzyme modified cheeses

Enzyme modified cheeses are playing an increasingly important role in flavoring snack foods. Enzymes, such as gastric lipase are used to accelerate the cheese aging processing—resulting in more intense flavor of important flavor notes and reduced development time. These cheese flavors can replace as much as 15 times their weight in terms of flavor strength than regular spray dried cheeses, and up to 50% of the dehydrated cheese in a formulation. The reduced amount of solids can be made up with powdered cheese whey, non-fat milk and/or high acid butter milk.

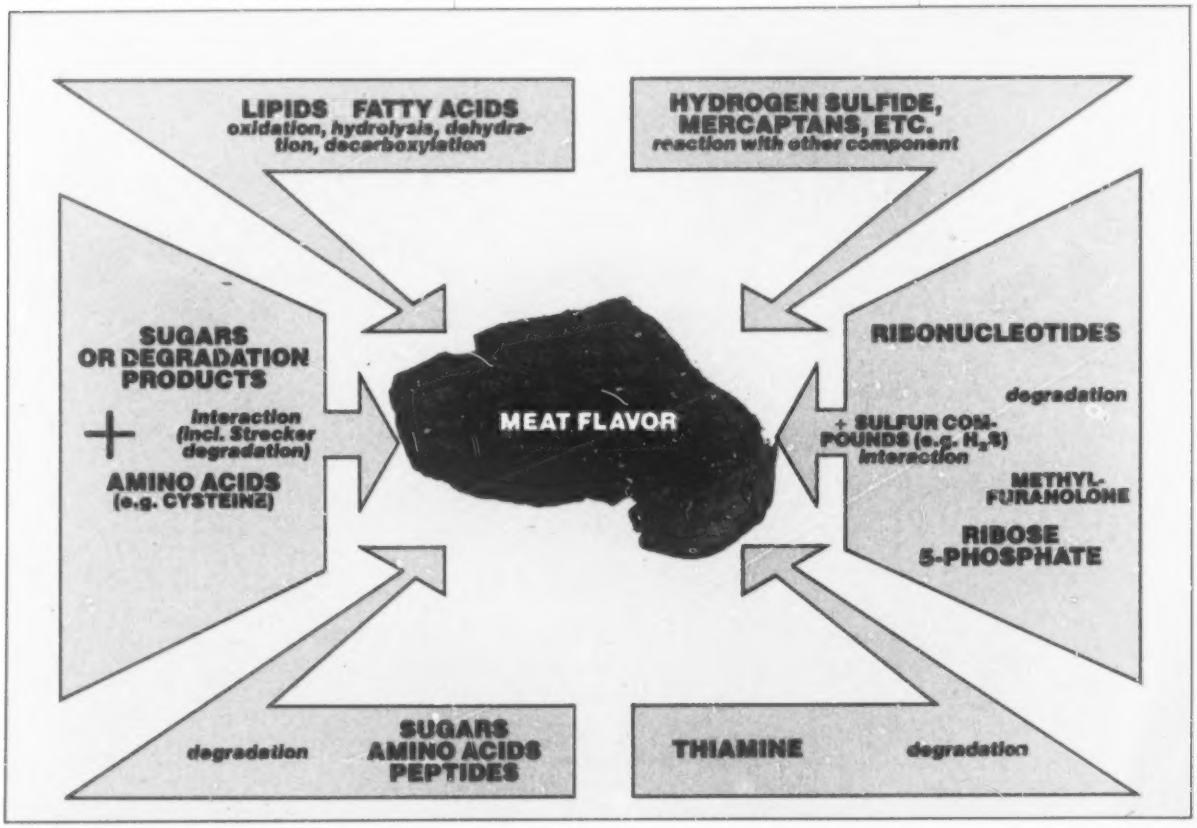
New versions of enzyme modified cheeses are appearing on the market. Beatrice offers a "wet cheese" which achieves intensified flavor by enzymes being released by the starter culture rather than by adding enzyme systems. Its flavor intensity is less than the traditional enzyme modified cheeses (or about three time that of sharper cheddar), but the product can be labeled as "cheddar cheese" rather than "natural flavors" or "enzyme-modified cheese."

Biotechnology also has played a part in the development of enzymes to accelerate flavor development during the aging process of cheese. Chr. Hansen's Laboratory, Inc., Milwaukee, Wisc., recently announced the commercial availability of *Flavor Age—FR*—a blend of lipase and protease enzymes which works in harmony with other naturally present enzymes. These microbially derived enzymes are a result of a joint agreement between Hanson's and Genencor, South San Francisco.

The lipase enzyme in this flavor development system breaks down milk butterfat to form a free fatty acid flavor profile similar to that of typical cheddar and cheddar-type cheeses. The manufacturer points out that the lipase in Flavor Age-FR is different from other commercially available lipases because it is water dispersible rather than water soluble. This allows the lipase to be more effectively entrapped in the

(Continued on page 72)

The development of meat flavors are becoming more sophisticated. Above photo courtesy of FIDCO Ingredients Development Co. Chart below courtesy of Dr. Charles Manley, National Starch & Chemical Corp.



A lab technician completes a pH test on a blended cheese flavoring. Photo courtesy of FIDCO Ingredients Development Co.

cheese matrix.

The protease enzyme accelerates the process by attacking the milk casein and breaking it down into peptides. These react with naturally occurring milk proteases and starter culture proteases to boost body breakdown.

Carrier systems for flavors

Flavors for extruded snack foods can be added to the system before extrusion or topically. Topical addition of flavor gives impact flavor while internal flavors provide a continuance of flavor. In using grains with more inherent flavor such as corn, topical addition of flavors is usually sufficient, points out Bill Zick of IFF.

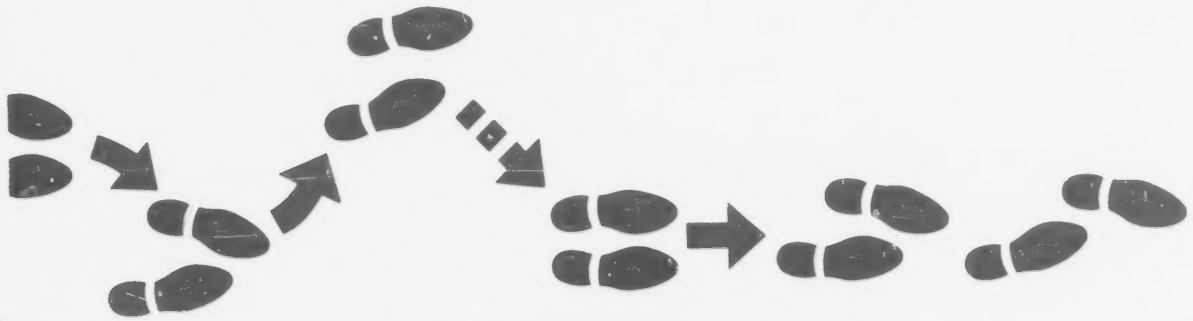
Spray dried flavors are often used for topical application to snack foods. Spray drying involves a continuous process of transforming a liquid feed into a dry, free-flowing powder. This is accomplished by spraying the feed into a hot drying chamber where water is removed and the dry product collected. Flavors are often spray dried with edible gums, starches and dextrins as encapsulating agents. These ingredients can protect the flavor constituents from volatile loss and/or oxidation.

Gum arabic is often included in the carrier matrix because of its excellent emulsifaction and film forming properties. Further, it contains minute amounts of natural antioxidants which help protect the flavor, points out John Scire, director of flavor development and flavor research for Fritzsche-Dodge & Olcott, New York. In the production of spray dried flavors, product quality is affected by inlet and outlet temperatures of the spray dryer, in-feed solid content, particle size distribution and volatility/solubility of the flavor constituents.

An example of the ingredients used in one type of encapsulated flavors from Durkee are: maltodextrin, gum arabic, flavor, emulsifier and silicondioxide. The company uses a process of extrusion encapsulation to increase stability of flavor chemicals solubilized in oil, alcohol, propylene glycol or water.

A number of extrusion stable flavors, which are combined with the cereal matrix prior to extrusion, are available. Since extrusion involves subjecting the raw material to high temperatures and pressure prior it being forced through an extruder-die, the flavoring material must be able to withstand extreme conditions. The high pressure and temperature prior to extruding results in the cereal matrix expanding after passing through the die.

Naarden International has done work with pre-extrusion flavored filled snacks—where the extrusion and filling of a snack occurs simultaneously. The company has developed a cream



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filling which is stable during the extrusion process and storage. In addition, this cream filling has a low melting point and fat content.

Applying a fat coating to the outer side of the tube covering to prevent moisture absorption from the environment is recommended. The outer tube can be either flavored prior to extrusion with pre-extrusion flavors, or flavors can be "dusted on" directly after the fat coating is applied.

Another area where flavors have application in snack foods is their use in oils for frying. Beef tallow is used in some food service establishments for deep frying snack foods and other items. With required ingredient labeling of foods served away-from-home being discuss, interest has been generated in using vegetable oil for frying instead of the beef tallow. By flavoring the vegetable oil, the flavor contributed by the beef tallow could be maintained.

Another problem encountered when serving deep fried foods is maintaining consistent flavor. As new oil is added to a system to replace the oil absorbed by the food being fried, the oil's flavors changes. Filtering the oil also effects its flavor. IFF is currently looking at flavors for oils. Developing stability of these flavors—which would be subjected to the high temperature of frying—is a major obstacle.

Demand for natural remains

Developing consistent sources for natural raw materials and discovering natural processes for providing flavors is the direction of much of today's flavor research. And, it doesn't appear that this direction will change in the near future. Both microbiologist and enzymologist will be playing an increasingly important role in this area, since both of these areas fall within the government's definition of natural processes. Other methods considered as natural processes include fermentation, extraction and separation techniques, genetic changes (which will require FDA approval), and heating within certain limits.

"Natural is a legal, not a scientific definition," explains Michael Brooks, Chief Flavor Chemist at H. Kohnstamm.

Yet, while discussions concerning the definitions of natural flavor continue so does the research into securing new, consistent sources of raw flavoring materials and the search for economically feasible methods the develop natural flavors within current requirements.

Flavors II, which will appear in April, will look at vanilla and fruit flavors and their role in flavoring products such as beverages (still and dry mix), dry mix desserts and other products.

(Continued on page 74)

"Naturalness, self-awareness and health are the three major driving forces spurring today's new food product activity," . . . Bill Zick, vice president of business development for the flavor division of International Flavors & Fragrances.

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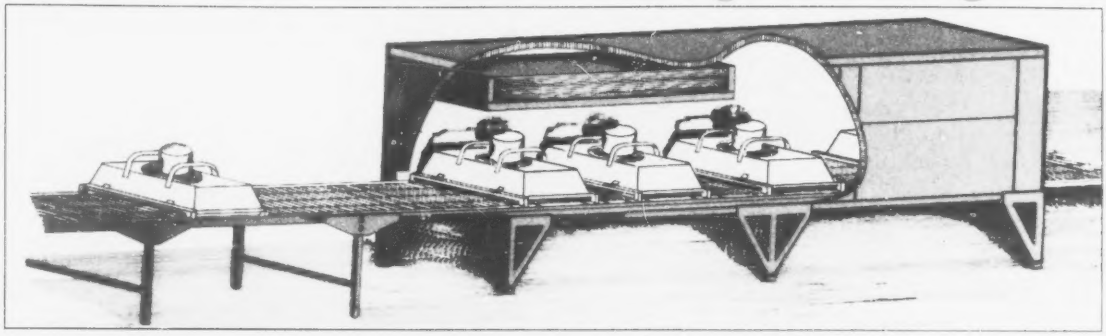

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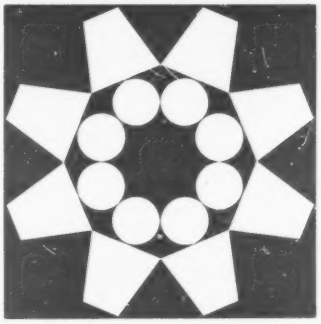

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2nd International
Trade Show and Congress
for Food Processing

**Cologne, Germany –
April 21 to 25, 1986**

From April 21 to 25, 1986, the 2nd INATEC-International Food Technology Congress and Trade Fair – will be held in Cologne, Germany. This special event, which takes place every three years, will focus both on process technology in the food industry and on measurement and control technology.

The INATEC Congress will take place in the adjoining Congress Center East. It is aimed at food manufacturers, technicians and scientists from the area of food technology and process technology and at manufacturers of machines and equipment for the food industry.

INATEC Cologne 1986 has received Certification by the U.S. Department of Commerce, making it the most significant international event in 1986 for export sales of the American Food Processing Machinery and Supplies Industry.

International world famous congress speakers representing science and practical users will focus on the following subjects:

- **mechanical process technology**
- **thermal process technology**
- **combined process technology**
- **measuring – controlling – regulating**

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Special Emphasis

FLAVORS/PART I

Finding sources for natural flavors poses problems

In the U.S. only flavors isolated from a natural material by physical methods can be labeled as natural. Until recently, it has not been possible to determine the source and method used to produce a flavor. With numerous imported food products in this country and the differing definitions, this has caused some concern—especially since many nature-identical flavors are less expensive to produce than their natural counterpart.

Isotopic methods are now being refined which can be used to establish a flavor origin and the method used to produce it. The method involves measuring the amount of C_{13} and C_{14} in the flavor. Since many natural flavors have plant sources while their nature-identical counterparts often use petroleum or coal tar as a starting point, this method has proven effective. Much methodology has yet to be worked out.

The Flavor and Extract Manufacturers' Association (FEMA), which is engaged principally in activities which assure its members of a substantial supply of safe flavor materials, is funding research to develop this methodology further. It recently reached an agreement with the Center for Applied Isotopic Studies (CAIS), University of Georgia, for a five-year joint study with FEMA on the application of isotopic ratios and other analytical procedures to detect adulteration in flavoring materials.

Natural benzaldehyde (or pure bitter almond) is one of the primary flavors that FEMA is interested in monitoring. Natural benzaldehyde was produced from apricot and peach pits at one time. Glucoside from the pits was converted to benzaldehyde and glucose, with hydrogen cyanide prussic acid as a by-product. But now peach and apricot pits are used to product laetrile—a more lucrative product.

France offered a product labeled oil of benzaldehyde, but in late 1984 CAIS discovered, through isotopic methods, that the benzaldehyde was made from toluene at a fraction of the price of producing natural benzaldehyde. High fractionation columns were used to remove the impurities.

Fries & Fries and others have introduced a natural benzaldehyde recently, but the price is considerably higher than any other source of benzaldehyde available. Currently, this leaves users of benzaldehyde three choices: 1) Label their product as natural and artificially flavored; 2) Pay much more for the natural flavor; or 3) Revise their formula.

Several years ago the Bureau of Alcohol, Tobacco & Firearms withdrew a proposal for ingredient labeling of alcoholic beverages and decided to determine case by case which ingredients, due to health risks, should be labeled. Presently, only FD&C Yellow Dye No. 5 must be labeled. Proposals to label sulfites over 10 ppm and saccharine are pending.

The source of benzaldehyde is not a question of safety but of economics. And, labeling the source of benzaldehyde doesn't become an issue unless the manufacturer wants to declare its product as all natural on the label. Then to get label approval from the Bureau all ingredients must be certified as natural.

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